CLAIMS

What is Claimed is:

1. A fuel cell system comprising:

a fuel cell stack generating output power and heat, said fuel cell stack being responsive to a coolant on a coolant input line and outputting heated coolant on a coolant output line; and

a heat pump module responsive to the heated coolant on the coolant output line, said heat pump module including a compression device that compresses the heated coolant to raise its temperature and pressure, said heat pump module further including a cooling device that is responsive to the heated and compressed coolant from the compression device, said cooling device reducing the temperature of the compressed coolant, said heat pump module further including an expansion device responsive to the cooled and compressed coolant from the cooling device, said expansion device decreasing the pressure and temperature of the coolant to further cool the coolant, where the cooled coolant is applied to the fuel cell stack on the coolant input line.

2. The system according to claim 1 further comprising a hydride bed, said compressed coolant from the compression device being applied to the hydride bed to heat a hydride therein and release hydrogen, said coolant from the hydride bed being applied to the radiator.

3. The system according to claim 2 wherein the coolant is hydrogen.

4. The system according to claim 1 wherein the cooling device is selected from the group consisting of radiators and cooling fins.

5. The system according to claim 1 wherein the expansion device is an orifice separating a high pressure chamber and a low pressure chamber.

6. The system according to claim 1 wherein the fuel cell system provides power to a vehicle.

7. A fuel cell system comprising:

a fuel cell stack generating output power and heat, said fuel cell stack being responsive to a stack coolant on a coolant input line and outputting heated stack coolant on a coolant output line; and

a heat pump module, said heat pump module including a heat exchanger responsive to the heated stack coolant on the coolant output line, said heat exchanger also being responsive to a heat pump coolant, said heat pump coolant cooling the stack coolant before it is applied to the coolant input line, said heat pump module including a compression device that compresses the heat pump coolant from the heat exchanger to raise its temperature and pressure, said heat pump module further including a cooling device that is responsive to the heated and compressed coolant from the compression device, said cooling device reducing the temperature of the compressed coolant, said heat pump module further including an expansion device responsive to the cooled and compressed coolant from the cooling device, said expansion device decreasing the pressure and temperature of the coolant to further cool the coolant, wherein the cooled heat pump coolant is applied to the heat exchanger.

8. The system according to claim 7 further comprising a hydride bed, said compressed coolant from the compression device being applied to the hydride bed to heat a hydride therein and release hydrogen, said coolant from the hydride bed being applied to the radiator.

9. The system according to claim 8 wherein the coolant is hydrogen.

10. The system according to claim 7 wherein the cooling device is selected from the group consisting of radiators and cooling fins.

11. The system according to claim 7 wherein the expansion device is an orifice separating a high pressure chamber and a low pressure chamber.

12. The system according to claim 7 wherein the fuel cell system provides power to a vehicle.

13. A fuel cell system comprising:

a fuel cell stack generating output power and heat, said fuel cell stack being responsive to a coolant on a coolant input line and outputting heated coolant on a coolant output line; and

a heat pump responsive to the heated coolant on the coolant output line, said heat pump including a compression device for compressing the heated coolant and an expansion device for expanding the compressed coolant.

14. The system according to claim 13 further comprising a hydride bed having sufficient heat consumption to accept all the heat produced by the fuel cell, said compressed coolant from the compression device being applied to the hydride bed to heat a hydride therein and release hydrogen, said coolant from the hydride bed being applied to the expansion device.

15. The system according to claim 14 wherein the coolant is hydrogen.

16. The system according to claim 14 wherein the expansion device is an orifice separating a high pressure chamber and a low pressure chamber.

17. The system according to claim 14 wherein the fuel cell system provides power to a vehicle.